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ABSTRACT

A few empirical studies of mnemonic techniques were conducted in the late 1800s and early 1900s. Then, until the 1960s, very little research was done on mnemonics. A revival of research interest in mnemonics, in the late 1960s, accompanied the general acceptability of cognitive processes as a legitimate area of research. Now we're back where we started a century ago--studying mental processes. Visual imagery has played a central role in mnemonic techniques and systems since ancient times, and recent research has indicated that imagery can be a powerful learning aid for many kinds of verbal material. Strategies that have been recommended for making effective visual associations include forming a visual image of two items interacting with each other, picturing the image vividly, and using bizarre associations. Recent research has found that interaction and vividness are important, but that bizarreness is probably not important. Recent research has also indicated that it is generally more effective for learners to construct their own mediators than to have them provided by someone else. Finally, researchers in the 1970s have suggested, as was also suggested a century ago, that mnemonics may have applications useful in education. (Author/GW)

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A Century of Research on Mnemonics: We're Back Where We Started

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The title of this paper may carry a negative connotation to some people, suggesting that we have not made any progress in our knowledge of mnemonics during the last century. This is not what it is intended to suggest. The reference to being "back where we started" refers to the current empirical investigation of memory issues and questions that existed at least a century ago. Although most of our research findings on mnemonics are new, many of the issues are old. This does not mean that we are not also breaking new ground, but only that at least some of the ground was plowed long ago.

The word mnemonic means "aiding the memory." Thus a mnemonic system or technique is a system or technique which aids the memory, and mnemonics refers in general to methods of memory improvement. Typically, however, the term is used to refer more specifically to rather unusual, artifical memory techniques, the kinds of techniques recommended in popular memory-training books. These would include such techniques as visual imagery, verbal mediators, stories, rhymes, acrostics, and acronyms.

The use of mnemonic systems dates back more than 20 centuries (their history from about 500 B.C. through the seventeenth century has been traced by Yates, 1966). My interest in mnemonics dates back about 20 years, to the time I read a popular memory-training book on mnemonics as a student in high school. The study and use of mnemonics was just a hobby for me until a few years ago, when I developed a university course which I entitled, "Understanding and Improving Your Memory." Part of the course deals with mnemonics. During the last year, my study of mnemonics has become even more concentrated, as I have been working on a book on memory improvement, to be published at the first of next year. The book includes descriptions of mnemonic techniques and systems, their strengths and limitations, research evidence as to how well they work, and suggestions as to how they can be used. Much of this paper draws from material prepared for the book.

As the title suggests, the orientation of this paper is historical. The purpose of the paper is to compare some of the recent research evidence with some of the older evidence and statements on mnemonics. I am defining "recent" as meaning the 1960's and 1970's, and "older" as meaning anywhere from 60-2500 years ago (with the emphasis being on the last century). I have not attempted a comprehensive review of research on mnemonics in this paper. Such a feat would have been virtually impossible even a century ago--an 1813 book listed about 60 references on memory improvement (Feinaigle, 1813), an 1852 source mentioned some 140

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CS 003 574

works on mnemonics, and an 1888 book by G. S. Fellows listed a bibliography of 247 works on mnemonics and memory training (cf. Burnham, 1888). A recent bibliography which was limited only to visual imagery and memory for pictures listed 685 references (Standing, Bond, Hall, & Weller, 1972).

The Legitimacy of Mnemonics

Even though mnemonic techniques and systems have been in use for more than 20 centuries, virtually all of the experimental research on mnemonics has been conducted since 1960. Why?

Brown and Deffenbacher (1975) have suggested that a reading of contemporary works on mnemonics gives the impression that the study of mnemonics and mnemonists has been more limited than is the case historically. The topic was actually of considerable interest during the 1800's, and Brown and Deffenbacher review and describe some research done on mnemonists during the 1800's and early 1900's by men such as Binet and Müller.

Brown and Deffenbacher considered several possible reasons for the lack of current awareness of this historical research by American psychologists, and concluded that the most likely reason was the behaviorist slant of American psychology during the first half of the 20th century. Likewise, I would suggest that probably the major reason why there was virtually no research on mnemonics during the first half of the 20th century is that mental processes was not a very legitimate area for research. As psychologists concentrated on observable behavior in order to be scientific, very little research was done on mnemonics. Mnemonic systems were taught in memory-training books and commercial courses, used by mnemonists to perform amazing memory feats, and ignored by most psychologists. A revived research interest in mnemonics in the late 1960's accompanied the general acceptability of cognitive processes as a legitimate area for research. It is this return to the study of mnemonics, especially visual imagery, that is the primary meaning of the phrase, "We're back where we started," in the title of this paper.

Much of the early "research" on mnemonics would not really be considered to be research by today's standards. The studies used very small numbers of subjects. They relied almost entirely on introspection (though that method has also regained some legitimacy for studying cognitive processes, McKellar, 1972). In addition, the studies were not well-controlled. For example, most current researchers who compare learning by different mnemonic instructions include a check to determine the extent to which the subjects followed the instructions. Contrast this with a study published in 1894 comparing different learning strategies, in which it was reported, "How closely they followed these directions it is impossible to say, but their faces indicated that they were trying to do so" (Kirkpatrick, 1894, p. 603).

In addition to the behaviorist influence, a second possible reason why mnemonic systems may not have been viewed as a legitimate area for scientific inquiry for so many years is that they were associated with sensationalism, showmanship, and commercialism. Researchers may have thought

that research on mnemonics would yield little useful knowledge about memory, or that such gimmickry was not worthy of serious scientific study.

Donald Norman introduced a chapter on mnemonics as follows:

> Throughout the centuries man has been concerned with the practical art of memory. Everyone knows that normally it is difficult to memorize things. Yet a few people have always known special techniques that make the task possible with apparent ease. We tend to ignore these techniques today because they are mere tricks and sophistry--the practitioners exhibit themselves as stage entertainers or advertise themselves and their methods in unrespectable classified advertisements--but we cannot deny that the techniques work. In fact, we ought to examine procedures that simplify the job of memorizing with great care. Not only might they be useful in our lives, but the secrets of those who practice the art of memory ought to shed some light on the organization and operation of the mechanisms involved in memory. (1969, p. 98)

Gordon Bower (1970) has similarly observed that people have always searched for various rituals, tricks, gimmicks, and methods to improve their memories. He noted that the search has produced a few reasonably successful methods, which are advertised in sensationalistic terms in newspapers and magazines by commercial memory courses. He notes, "Although such hard-sell tactics are somewhat repugnant to respectable scholars (who view their grant proposals and fund-raising speeches in a different light), we should not be deterred by these commercial trappings from investigating scientifically some of the mnemonic devices" (p. 496). Fortunately, these commercial trappings have not deterred psychologists from scientifically investigating mnemonic devices in recent years.[1]

The emphasis in this paper is on the use of visual imagery as a mnemonic technique, for three reasons: (1) Visual imagery is probably the most unusual aspect of mnemonic systems, (2) it is used by virtually all mnemonic systems, and (3) it is the mnemonic technique that has been of most research interest during the last 10 years.

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[1]It should be noted, however, that the skepticism of some people regarding mnemonics is not limited to the 20th century. A 19th-century researcher quoted the following from a 17th-century document referring to teachers of mnemonics: "Many there be that at this day profess the same, though they get more infamy and disrepute than gain thereby; being a sort of rascally fellows that do many times impose upon silly youth, only to draw some small piece of money from them for present subsistence" (Burnham, 1888, p. 86). The researcher then went on to say, "There is at least this difference between the mnemonic teachers of Agrippa's time and those of the present. The latter generally get, not a small piece of money, but a large piece, and they sometimes impose upon others as well as silly youth" (pp. 86-87).

Of course, not all mnemonic techniques involve visual imagery. Acrostics and acronyms are verbal mnemonics. Verbal mediators have been of considerable research interest, usually consisting of using a sentence to connect the stimulus and response words in paired-associate learning. The narrative story technique (cf. Bower & Clark, 1969) is an extention of verbal mediators to associate more than two words in a series. Many studies have compared the effectiveness of verbal and visual mediators. Although some studies have found no significant differences between verbal and visual mediators (e.g., Dempster & Rowhrer, 1974; Foth, 1973), the usual finding is that visual mediators are more effective than verbal ones for remembering concrete words, whereas verbal mediators may be more effective for abstract words (cf. Bower & Winzenz, 1970; Bugelski, 1970; Paivio, 1971, 1972, 1975; Prestianni & Zacks, 1974).

Throughout the paper I have quoted from a well-known memory-training book by David Roth (1918) to exemplify the popular ideas of the late 1800's and early 1900's, and a best-selling memory-training book by Harry Lorayne and Jerry Lucas (1974) to exemplify current popular ideas.

In order to limit the scope of the paper to a manageable size, I have chosen to discuss only the following areas of visual mnemonics: The effectiveness of visual imagery in general, factors determining the effective use of visual imagery (interaction, vividness, bizarreness), own- vs. other-supplied mediators, and educational implications.

Visual Imagery: Old and New

Old

The origin of mnemonics is usually traced to the early Greeks about 500 B.C. Imagery played a central role from the very beginning. Cicero, writing in De oratore, described the procedure as follows:

> Persons desiring to train this faculty (of memory) must select places and form mental images of the things they wish to remember and store those images in the places, so that the order of the places will preserve the order of the things, and the images of the things will denote themselves (Yates, 1966, p. 2).

This emphasis on visual imagery continued through the centuries. Probably the earliest research study which actually provides some empirical support for the memorability of pictures vs. verbal material is that of Kirkpatrick (1894). Kirkpatrick studied memory for objects vs. the names of the objects in elementary school, high school, and college students. Some subjects were shown 10 objects, and others were shown the names of the objects. He found that there was a slight advantage for immediate recall memory of objects over memory of names of the objects. After three days, the difference in recall was more striking. People who were shown the objects recalled seven times as much as people given the names of the objects (means were 6.29 vs. .91). Calkins (1898) obtained similar results using pictures of objects rather than the objects themselves. Moore (1919) found

similarly that objects were recalled better than pictures, and pictures better than words. All these studies suggest indirectly that visual imagery may be helpful, but do not provide direct evidence.

Fracker (1908) reported eight experiments on memory for different kinds of material, and concluded that, "some elements concerned in improvement and transference have been enumerated. Of these the central or most essential element is individual imagery" (p. 101). A memory course published in the early 1900's emphasized visual associations: "Practically all mental action and development are based on the Association of Ideas and the use of the visual faculty," and "You are going to learn association and to visualize your ideas" (Roth, 1918, Lesson One, pp. 5-6). This emphasis on visual imagery has continued in current memory-training books (e.g., Lorayne & Lucas, 1974).

New

Research on visual imagery provides a specific example of the previous discussion on the legitimacy of mnemonics. Imagery was not a legitimate field of scientific study for most psychologists from the early 1900's until the 1960's, because it was not a behavior that could be outwardly observed and measured (cf. Bugelski, 1970; Holt, 1964; Paivio, 1971). In fact, in an extensive survey of the field of human learning published in 1952 (McGeoch & Irion, 1952), mental imagery and visualization were not even mentioned. The number of references appearing under "Imagery" in Psychological Abstracts was 8 in 1960, 19 in 1965, 62 in 1970, 98 in 1975. Much of the considerable research done on visual imagery, including imagery in memory, during the 1960's has been summarized in several books published in the early 1970's (Paivio, 1971; Segal, 1971; Sheehan, 1972).

The saying that "one picture is worth a thousand words" is usually applied to the effectiveness of a picture in communicating an idea that would take many words to express; it may also apply to the effectiveness of a picture in remembering what was communicated. Several recent studies have replicated the older findings reported above that objects are more memorable than pictures, and that pictures of objects are more memorable than the names of the objects, both by young children and by adults (e.g. Bevan & Steger, 1971; Cole, Frankel, & Sharp, 1971; Gounard & Keitz, in press; Levie & Levie, 1975; Westman & Delprato, 1974). In addition, pictures of objects have been found to be more memorable than verbal descriptions of the objects (Denis, 1973). There is evidence that recognition memory for pictures may be virtually unlimited (cf. Shepard, 1967; Standing, 1973; Standing, Conezio, & Haber, 1970).

Besides the finding that pictures are more memorable than words, another reason why visual imagery may be effective has been suggested by Allan Paivio (1971, 1972, 1975)--words which evoke images may be coded dually (in both verbal and visual memory) so there is twice as great a likelihood of remembering them. There are other theories about why imagery can be such a powerful memory aid (cf. Anderson & Bower, 1973; Paivio, 1975), but regardless of the reason, the important point for mnemonics is that visual imagery can help memory for verbal material.

Paired-Associate Learning

Most of the studies on the use of visual imagery (and also those on verbal mediation) have used a paired-associate task. Of the many paired-associate studies that show the effectiveness of visualization, I will briefly report the results of five studies which illustrate different points.

In one widely-cited study (the only one I know of that was conducted in the 1950's) pairs of common nouns were read to people at their own pace, and they formed bizarre mental images combining each of the pairs. They were able to accurately recall 99% of 500 pairs of words, and 95% of 700 pairs (Wallace, Turner, & Perkins, 1960). In a second study, people who were instructed to use imagery were compared with people who were simply told to study and rehearse the word pairs. Both groups spent the same amount of time studying the material, but the imagery group showed 80% recall whereas the control group showed only 33% recall (Bower, 1972). In a third study, people learned six different lists of 10 pairs of words. At the end of the six lists, they were tested on recall of all 60 words. The imagers recalled an average of 63%, while the non-imagers recalled an average of 22% (Bugelski, 1968).

While most studies have used between-subjects designs, a fourth study used a within-subjects design. People used imagery to learn some words and repetition to learn others. Their recall averaged between 80-90% of the words learned by imagery, and 30-40% of the words learned by rote repetition (Schnorr & Atkinson, 1969). A fifth study showed that visualization can be effective in young children also, increasing paired-associate recall by two times in first graders and four times in fourth graders (Kemler & Jusczyk, 1975).

Other Verbal Learning

Although most of the research on imagery has used paired-associate learning of nouns, its value is not limited to nouns. Imagery has also been found to aid memory for verbs and adverbs (Pate, Ward, & Harlan, 1974). Nor is the value of imagery limited to memory for single words. Visual imagery has been found to help in learning sentences (Anderson & Hidde, 1971; De Villiers, 1974; Jusczk, Kemler, & Bubis, 1975; Yuille & Holyoak, 1974), prose material (Kulhavy & Swenson, 1974; Lesgold, McCormick, & Golinkoff, 1975; Rasco, Tennyson, & Boutwell, 1975), and even concepts (Katz & Paivio, 1975).

Using Visual Imagery

The following advice for the effective mnemonic use of visual imagery was given about 2000 years ago in Ad Herennium (circa 86-82 B.C.):

> Now nature herself teaches us what we should do. When we see in everyday life things that are petty, ordinary, and banal, we generally fail to remember them, because the mind is not being stirred by anything novel or marvellous.

> But if we see or hear something exceptionally base, dishonourable, unusual, great, unbelievable, or ridiculous, that we are likely to remember for a long time....We ought, then to set up images of a kind that can adhere longest in memory. And we shall do so if we establish similitudes as striking as possible; if we set up images that are not many or vague but active; if we assign to them exceptional beauty or singular ugliness; if we ornament some of them, as with crowns or purple cloaks, so that the similitude may be more distinct to use; or if we somehow disfigure them, as by introducing one stained with blood or soiled with mud or smeared with red paint, so that its form is more striking, or by assigning certain comic effects to our images, for that, too, will ensure our remembering them more readily. (Yates, 1966, pp. 9-10)

This advice carried through the centuries. It was advised by memory-training courses in the 1800's and early 1900's. Consider the following suggestions by Roth (1918):

> Take advantage of the fact that things out of the ordinary impress us more than those that are commonplace. In order to retain your visual associations you must make them unusual. Some of us find it necessary to make these associations grotesque and ludicrous although I do not recommend the extreme use of this.(Lesson One, p. 9).
>
> Your mind's eye should <u>see</u> every picture clearly. (Lesson One, p. 12).
>
> You must have two objects in every picture. Do not make the mistake of forming a picture of only one object at a time. (Lesson One, p. 23).
>
> (If recall fails) it may be because you have merely thought of the two ideas, but have failed to actually see in your minds' eye the picture combining them, or because you have failed to imagine motion, color, or exaggeration in your pictures. (Lesson Five, p. 39).

Concerning the clarity of the images, Kirkpatrick (1894) felt that his research results gave some ground for saying, "Make the impressions vivid and the associations will take care of themselves" (p. 605).

These suggestions are still emphasized in current memory-training books, as the following examples show (Lorayne & Lucas, 1974):

> You need a ridiculous--impossible, crazy, illogical, absurd--picture or image to associate the two items. What you don't want is a logical or sensible picture. (p. 9).

> You needn't labor over seeing that picture. All it takes is a fraction of a second. Its the clarity of the picture that's important, not how long you see it. (p. 11).
>
> The one problem you may have in Linking, only at first, is in making your pictures ridiculous. There are four simple rules to help you do this right from the start. The easiest rule to apply is the rule of Substitution ....Another rule is Out of Proportion....Another rule is Exaggeration....And, try to get Action into your pictures. (pp. 15-16)

The above advice from the past and present suggests at least three strategies that may be used in making effective visual associations. First, form a visual image of the two items interacting with each other. Second, picture the image as clearly and vividly as possible. Third, use bizarre associations. Each of these suggestions has received recent research interest.

Interacting Images

Visual imagery by itself may not be too effective. Evidence indicates that to make visual association effective, imagery must both be "visual" and involve "association." It is necessary that the two items you are associating are pictured as interacting in some way with each other, rather than merely sitting next to each other, or one on top of the other. For example, if you were associating "dog" and "broom: it would be better to picture a dog sweeping with a broom than to picture a dog standing by a broom.

Research which has shown pictures to people, rather than having them make up their own mental pictures, has found that when the items in the picture are interacting, they are remembered better than when they are not interacting--both for young children (Horowitz, Lampel, & Takanishi, 1969; Nesbitt, 1974; Reese, 1972) and for college students (Bobrow & Easton, 1972; Wollen & Lowrey, 1971, 1974). Studies in which people made up their own mental pictures to remember words have also found that interacting imagery is more effective than separated images in paired-associate learning (e.g., Bower, 1970b; Morris & Stevens, 1974; Neisser & Kerr, 1973).

Ian Begg, who also found the effectiveness of interacting images over separate images, suggested that the reason for the effectiveness of interacting imagery is that images of separate items can be combined into a single image which operates as a unit in memory; the image is remembered as a unit, so that each part of the image serves as a cue for remembering the rest of the unit (Begg, 1973; Begg & Robertson, 1973). This suggests that chunking plays a role in the effectiveness of interacting imagery--one image represents the relationship among two or more items. It is interesting to note also that interacting imagery is rated as more vivid than separate images (Neisser & Kerr, 1973), which conveniently leads to the next point.

Vividness

A vivid visual image is one that is clear, distinct, and strong. For example, if you are associating "dog" and "broom", you should not just think about the words "dog" and "broom" together, or think about a dog sweeping with a broom, but should actually try to see the dog sweeping with the broom in your mind. It may help to make the picture detailed. What kind of dog is it? What kind of broom? Where is he sweeping? What is he sweeping? Picture a dachshund sweeping mud off your porch with a pushbroom; or a bulldog sweeping food off the kitchen floor with a straw broom. Some other suggestions that have been recommended since ancient times to make visual associations effective are aimed at making them more vivid: motion (see the picture in action--the dog is sweeping with the broom, not just holding it), substitution (see one item in place of the other--you are sweeping with a dog instead of a broom, or a broom is coming out of a doghouse), exaggeration (see one or both of the items exaggerated in size or number--a Chihuahua is sweeping with a giant broom, or a St. Bernard is using a small whisk broom).

There are several different kinds of studies which suggest that visual associations should be vivid to be remembered. In one study of imagery in paired-associate learning, people rated the vividness of their images as they constructed them. For every person, the more vivid the images were rated, the better they were recalled (Bower, 1972). This positive relationship between recall and vividness of imagery has also been found for sentences (Anderson & Hidde, 1971). Delin (1969) found that students instructed to make vivid mental images tended to remember a list of words better than students told only to make mental images; students instructed to make vivid, active images tended to perform even better.

People learned concrete sentences or paragraphs that described events with either high or low vividness (the vivid descriptions were more emotional, colorful, and forceful, and yielded more graphic imagery). The vivid sentences and paragraphs were recalled better than the non-vivid ones (Anderson & Hidde, 1971; Holmes & Murray, 1974; Montague & Carter, 1973). Similarly, including vivid adjectives in paragraphs can result in better recall of the paragraphs than using "dull" adjectives (Kirchner, 1969), and vivid pictures (like a crashed airplane) are remembered better than normal pictures (like a flying airplane--Standing, 1973).

Bizarreness

Another recommendation that has come down through the ages is that visual associations must be bizarre (unusual, weird, implausible, incongruous, or ludicrous). The opposite of bizarre would be plausible--a picture that makes sense, and could really occur. For example, in associating "dog-broom," a picture of a dog being chased out of a house by a person with a broom is plausible; a dog sweeping with a broom would be somewhat bizarre; and a dog riding a broom like a witch, or a person sweeping the floor with a dog tied to the end of a broomstick would be bizarre.

Three studies provide evidence that bizarre imagery can be effective, but these studies did not compare bizarre imagery directly with plausible imagery to see if it is more effective than plausible imagery (Briggs, Hawkins, & Crovitz, 1970; Delin, 1968; Persensky & Senter, 1969). Most research that has made such a direct comparison has found no difference between bizarre and plausible imagery. Studies have found that bizarre imagery is not more effective than plausible imagery in paired-associate tasks (Nappe & Wollen, 1973; Wortman & Sparling, 1974), or in tasks using mnemonic systems (Bower, 1970; Wood, 1967).

Hock and Romanski (1975) found that novel visual associations between objects helped memory for the objects more than did common associations, as long as the novel associations were plausible. However, implausible novel associations were no more effective than common plausible associations. (A man playing a harp is an example of a common plausible association; a man sitting on a harp is a novel plausible association; a harp playing a man is an implausible novel association.)

Wollen, Weber, and Lowry (1972) compared the importance of bizarreness vs. interaction. People saw pictures of two objects, which varied in whether the objects were bizarre or common and whether they were interacting or separate. Interacting pictures were recalled better than non-interacting pictures, but bizarreness did not affect recall.

Thus, there is considerable evidence that bizarre visual associations are not more effective than plausible ones. There is even one study which suggests that bizarre images may be less effective (Collyer, Jonides, & Bevan, 1972).

When bizarreness does help, it is likely because bizarre images incorporate other factors which help memory. Thus, some interacting images may almost have to be bizarre in order to involve interaction (for example, it is hard to think of a plausible picture showing an elephant and a piano interacting). Bizarre images may be more vivid than plausible images. Bizarre images tend to be unique, and the uniqueness of an image helps memory (Lesgold & Goldman, 1973). Bizarre images take more time to form than do plausible images (Nappe & Wollen, 1973; Wortman & Sparling, 1974), and extra time spent on an image may increase its memorability.

However, all of these factors (interaction, vividness, uniqueness, extra time) can also be used in images which are not bizarre. It is not necessary that an image be bizarre to incorporate these factors. One popular memory-training book (Lorayne & Lucas, 1974) illustrated the advantages of bizarre associations by the following examples for associating airplane and tree: A logical picture would be an airplane parked near a tree--since that is possible, the book said, it probably will not work; better pictures would be airplanes growing on trees, or trees boarding an airplane. It is true that the latter examples would be more memorable than a plane parked near a tree. However, it is also true that plausible pictures involving interaction, vividness, and uniqueness would also be more memorable; for example, a low-flying airplane shearing the tops off trees, or an airplane crashing into a tree.

One reason why bizarreness may be ineffective for some people is that some people have a hard time making up bizarre images (Delin, 1969; Gruneberg, Monks, Sykes, & Oborne, 1974). The person who finds it difficult to make up bizarre images, or who feels uncomfortable doing so, can concentrate on making the images interacting and vivid, and not worry about making them bizarre. On the other hand, the person who does not have any trouble imagining bizarre associations, and who feels comfortable with them, can go ahead and use them. The research findings do not mean that bizarreness does not help, but only that it is not necessary.

Own- vs. Other-supplied Mediators

In ancient times it was considered advisable for the learner to construct his own associations, rather than have them given to him by someone else. Yates (1966) reported that though the ancient memory treatis would always give the rules, it rarely gave any concrete application of the rules. She reports that this tradition was started by the author of Ad Herennium, who said that the duty of an instructor in mnemonics is to teach the method of making images, give a few examples, and then encourage the student to form his own. This suggestion has carried to modern memory books, as Lorayne and Lucas (1974) advise, "You're much better off, incidentally, thinking up your own pictures" (p. 11).

There is a considerable amount of recent research evidence which supports this claim. Both visual and verbal mediators tend to be more effective if the subject thinks them up himself than if they are given to him by the experimenter (Bower & Winzenz, 1970; Bugelski, 1970; Griffith, 1976; Kemler & Jusczyk, 1975; Ley & Hubba, 1975), one possible reason being that other people suggest different associations from those you would make up yourself (Schwartz & Walsh, 1974). However, people who may not be able to construct good mediators--such as young children (Robinson & London, 1971) and mental retardates (Borkowski & Wanshura, 1974)--may benefit by having associations suggested to them.

Educational Implications of Mnemonics

Francis Galton published a survey in 1883, in which he investigated the vividness of visual imagery in 100 adult men. He asked them to imagine given objects, then asked them questions about the nature of their images and found considerable individual differences (see Galton, 1907). Even though he felt that "the visualizing faculty is a natural gift" (p. 69), he suggested that "There is abundant evidence that the visualizing faculty admits of being developed by education" (p. 73). He further suggested that the faculty is worth developing:

> There can, however, be no doubt as to the utility of the visualizing faculty when it is duly subordinate to the higher intellectual operations...I believe that a serious study of the best methods of developing and utilizing this faculty, without prejudice to the practice of abstract thought in symbols, is one of the many pressing desiderata in the yet unformed science of education. (1907, p. 79)

Similarly, Kirkpatrick suggested in 1894 that,

> The fact that mental images of objects are remembered better than their names is of great pedagogical significance, indicating that if objects are shown children, or when that is impracticable, if they are led to form mental images of them, they can obtain a genuine knowledge of things more readily than they can be crammed with the verbal appearance of knowledge. (1894, p. 605).

In a 1909 book discussing experimental research on memory, Henry Watt concluded a chapter on mental imagery in memory with the statement that, "The need for visual and pictorial demonstration is being recognized more and more in our higher education " (1909, p. 108).

A number of researchers have likewise suggested during the 1970's that mnemonics, including visual imagery, may be valuable in education. Cermak (1972) predicted that mnemonic methods of organization will someday be taught as a high school subject; Bower (1973) has suggested a number of educational uses of mnemonics in rote learning situations; and Paivio (1971) has suggested that "Probably the most important practical outcome of research on imagery and verbal processes will be in relation to problems of education" (p. 532).

There are at least two ways in which mnemonic imagery has implications for educational uses (cf. Rohwer, 1970; Russell, 1974). First, it has implications for the way in which instructional materials can best present information to students to help learning and retention (for example, concrete vs. abstract, pictorial vs. verbal, interacting vs. separate). Second, it has implications for the kinds of activities students should be taught to increase their power of learning (for example, verbal and visual elaboration).

Miscellaneous Memory Matters

As noted at the beginning of the paper, I have been selective in discussing areas of ancient origin which have generated recent research interest. A major area that I have not even touched on is the effectiveness of mnemonic systems, such as the Method of Loci and various peg systems. I have located at least two dozen studies published in the last 10 years, investigating mnemonic systems at least three centuries old (I have reviewed these studies elsewhere, Higbee, 1976). Nor is the similarity between older ideas and current research limited to mnemonics. For example, the three stages of memory--acquisition, storage, and retrieval--are apparent in Loisette's "three conditions of memory--(1) Impression. (2) Its Preservation. (3) Its Revival" (1899, p. 2). As another example, the information-processing approach to memory uses the analogies of a library or warehouse to illustrate the effect of storage on retrieval and the importance of organization in memory. This makes the following 163-year-old analogy seem very up-to-date:

> The memory may be compared to a warehouse stored with merchandise. A methodical arrangement of the contents of such a repository, enables its owner to find any article that he may require, with the utmost readiness. With a general knowledge of the contents of a library, and of the manner in which the books are distributed, a person may, even when absent from the spot, determine, with certainty, the situation of any particular book (Feinaigle, 1813, p. 21).

Of course, William James' timeless Principles of Psychology, published in 1890, contains many comments with a contemporary ring to them (the following examples are excerpted from the 1899 edition): On the use of "mental elaboration," a term currently widely applied by researchers on mnemonics--"It will now appear clear that all improvement of memory lies in the line of elaborating the associates of each of the several things to be remembered" (p. 663). On the importance of association in mnemonic elaborations--"The 'secret of a good memory' is thus the secret of forming diverse and multiple associations with every fact we care to retain" (p. 662). On the advantage of distributed learning over massed learning--"Speedy oblivion is the almost inevitable fate of all that is committed to memory in this simple way (cramming)....Of course there is no moral turpitude in cramming. If it led to the desired end of secure learning it would be infinitely the best method of study. But it does not; and students themselves should understand the reason why" (p. 663). On the importance of storage in later retrieval--"All improvement of memory consists, then, in the improvement of one's habitual methods of recording facts" (p. 667).

Summary

In summary, I have suggested in this paper that much of our research on mnemonics has brought us back to where we started a century or more ago, in the sense that many of the areas of current research interest are of ancient origin. We are back where we started particularly in the sense that mnemonic strategies such as visual imagery are again legitimate topics to research and to discuss in scientific circles. Visual imagery has played a central role in mnemonic techniques and systems since ancient times, and research conducted in the last 15 years has indicated that imagery can, in fact, be a powerful learning aid for many kinds of verbal material. Several strategies have been recommended for the effective mnemonic use of visual imagery since ancient times, including interacting images, vividness, and bizarreness. Recent research has found that interaction and vividness are important, but that bizarreness is probably not important. Recent research has also indicated that it is generally more effective for the learner to construct his own mediators than to have them provided by someone else. Finally, researchers in the 1970's have suggested, as was also suggested a century ago, that mnemonics may have useful applications in education.

A psychologist commenting on mnemonic systems in 1909 observed that, "In principle such systems of memory training are all out of date, although in some cases their contents have not yet been tested or outreached in psychological experiments " (Watt, 1909, pp. 9-10). Although the first

part of this statement did not prove prophetic, the last part did. More than half a century later, psychologists began to seriously study systems of memory training and we can now say that "their contents" have "been tested in psychological experiments."

It seems appropriate to conclude this paper by borrowing the concluding remarks from a review of memory published nearly a century ago, because the conclusion applies as well today as it did then:

> In recent years the subject of memory has broadened. It is now connected with some of the most profound questions of psychology and biology. As the knowledge of these sciences has advanced, the importance of the study of memory has increased. Yet it is noteworthy that the beginning of the newer views is found in the doctrines of the older writers studied in this article. (Burnham, 1888, p. 90)

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